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Macrobenthic invertebrates community structure of river Tapti, a westerly flowing river in peninsular India

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Abstract A study was carried out to investigate the macrobenthic invertebrate community structure from the river Tapti from July 2017 to January 2020. A total of 49 taxa belonging to 2 phyla, 5 class, 17 orders, 26 families, and 31 genera were recorded from 13 sites of the river Tapti. Phylum Mollusca (58%) was the most dominant group, followed by Arthropoda (42%) in the community structure. The species *Tarebia lineata* and *Bellamya bengalensis* were the most abundant among the Gastropoda, *Parreysia favidens* and *Corbicula striatella* among the Bivalvia, and *Caenis* sp. and *Chironomus* sp. among the Insecta. The frequency and relative frequency of the species revealed that the most dominant species was *Bellamya bengalensis* from the class Gastropoda. The data generated in the present study will act as baseline information and would be useful in future studies for interpretation of the health of the Tapti river.

Key words River Tapti; Macrobenthic invertebrates; species diversity, India

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Introduction

River Tapti is one of the important westerly flowing rivers of peninsular India, arising from the Vindhya Mountain of the Satpura range in the state of Madhya Pradesh. The river flows westward through the states of Madhya Pradesh, Maharashtra, and Gujarat before meeting the Arabian Sea in the Surat district of state Gujarat. The total length of the river is 724 km from the origin at Multai, the river flows through rocky gorges of the Satpura ranges and opens out a few kilometers above Burhanpur town in Madhya Pradesh and courses through mountainous and dense forest regions of Maharashtra and Gujarat states and plains of Surat in Gujarat before emptying in the Arabian Sea. The upper stretch of the river is highly rocky and studded with boulders while the river bed in the lower stretch in the Gujarat state is mainly sandy and strewn with pebbles (Karamchandani and Pisolkar, 1967).

A freshwater environment is colonized by communities of plankton, periphyton, macrophytes, macro-invertebrates, fishes, etc. The distribution and abundance of these communities are greatly influenced by water quality and are useful in assessing the effects of pollutants. Benthic communities comprise of the flora and fauna inhabiting the bottom of a water body. Benthic communities are sampled to determine the species composition and abundance of organisms or to monitor long term changes in community structure (Sau *et al.*, 2017). Moreover, bivalves impact nutrient cycling, create and modify habitat, and affect food webs directly (i.e., prey) and indirectly (i.e., through the movement of nutrients and energy) (Vaughn and Hoellein, 2018). In freshwaters, infaunal mussels of the order Unionoida

Table 1. Details of sampling sites for macrobenthic invertebrates of river Tapti

Sampling site	Geographical coordinates	Habitat type	Anthropogenic stress
Multai	21° 44’00.5 “ N 78° 12' 21.2 “ E	Intermittent riverine stretch	Water abstraction for agriculture, fishing
Chandora	21°42’21.0"N 78°12’02.2"E	Pool	Fishing, water abstraction for agriculture
Betul	21° 49' 01.5 “ N 77° 45' 43.8 “ E	Seasonally variable pattern of macro-habitat like Pool, Run, rapids, glides and riffles	Water abstraction for agriculture, sand mining, stone crushing, fishing Dynamiting, water abstraction for agriculture,
Dedtalai	21°31' 01.9 “ N 76° 45' 28.9 “ E	Seasonally variable pattern of macro-habitat like Pool, Run and glides	fishing
Nepanagar	21° 25' 09.3 “ N 76° 22' 49.0 “ E	Seasonally variable pattern of macro-habitat like Pool, Run, rapids, glides and riffles	Dynamiting, water abstraction for agriculture, fishing, domestic sewage discharge
Burhanpur	21°16' 56.8 “ N 76°13’20.8 “ E	Seasonally variable pattern of macro-habitat like Pool, Run, rapids, glides and riffles	Urban sewage discharge, sand mining, use of fish poison, fishing Waste disposal from religious rituals, Outboard
Changdev	21°5’40.3'' N 76° 0’16.2'' E	Seasonally variable pattern of macro-habitat like Pool and Run	Motor Boats, fishing
Bhusawal (Raipur)	21°03’52.4"N 75°51’04.9" E	Seasonally variable pattern of macro-habitat like Pool and Run	Water abstraction for agriculture, domestic sewage discharge, hot water effluent from thermal power plant, fishing
Bhusawal (Tapti Nagar)	21°04’01.2"N 75°46’48.7"E	Seasonally variable pattern of macro-habitat like Pool, Run, rapids, glides and riffles	Waste disposal from religious rituals, domestic sewage discharge, hot water effluent from thermal power plant Savkheda
Savkheda	21°08’58.8"N 75°14’01.7"E	Water velocity less, medium type riparian vegetation and forest, gravel bed	Semi-urban, domestic sewage, sand mining
Sarangkheda	21°25’41.1"N 74°31’48.6"E	Medium type water velocity, gravels with sands, medium type crop with riparian vegetations	Semi-urban, domestic sewage
Singalkanch	21°15’38.2"N 73°35’02.1"E	Stable water flow with undercut riparian forest	Semi-urban, agriculture, minimum anthropogenic stress
Kamrej	21°17’03.7"N	Sandy and clay soil, stable water 72°57’07.3"E	Urban, sewage and industrial effluents flow riparian vegetations

also form dense assemblages, often consisting of many different species which are critical to secondary production and element cycling in freshwater ecosystems (Strayer, 2008).

Macro-benthos plays a key role in the breakdown of particulate organic material and export energy to higher trophic levels and can potentially support off-shore and pelagic communities (Lee, 1997; Schrijvers *et al.*, 1996). The small changes in the environment will have a substantial response on the benthic community and macrobenthos can be used as a potential indicator to measure the degree of pollution (Coull, 1973; Fernando, 1981) and to assess the health of the ecosystem. Benthic communities are important to the marine ecosystem and form important food sources for most marine organisms, especially fishes. The estimation of benthic production would serve as a useful index for assessing the fishery potentials, interaction, pollution, and intertidal ecology. An assessment of the health of a particular ecosystem can be achieved only through a careful analysis of benthic fauna. Studies on benthic diversity, population dynamics, and changes caused by natural or anthropogenic processes are therefore essential for resource management (Raut *et al.,* 2005; Saxena and Kumar, 2009). In this context, a study was carried out to understand the current macrobenthic invertebrate diversity and community structure of the river Tapti, India.

Table 2. Station-wise systematic list of macrobenthic invertebrates recorded from river Tapti

Systematic list of macrobenthic invertebrates	Name of the stations												
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
Phylum- Mollusca													
Class- Gastropoda													
Order- Mesogastropoda													
Family- Thiaridae													
1. *Melanoides tuberculata*	+	-	+	+	+	+	+	+	+	+	+	+	+
2. *Thiara scabra*	-	-	-	-	+	+	-	-	+	+	-	+	-
3. *Tarebia lineata*	+	-	+	+	+	+	+	+	+	+	+	+	+
4. *Tarebia semigranosa*	-	-	-	+	+	+	-	-	-	+	+	+	+
5. *Tarebia granifera*	-	-	-	-	+	-	+	-	-	+	+	+	+
Family- Viviparidae													
6. *Bellamya bengalensis*	+	+	+	+	+	+	+	+	+	+	+	+	+
7. *Bellamya micron*	-	-	-	-	-	-	-	-	-	+	-	-	-
8. *Bellamya crassa*	-	-	-	+	+	-	+	+	-	+	+	+	+
9. *Bellamya dissimilis*	-	-	+	-	+	-	+	+	-	+	+	+	+
Family- Bithyniidae													
10. *Bithynia pulchella*	+	-	-	-	-	-	+	-	-	+	+	+	+
11. *Bithynia* sp.	+	+	-	-	-	-	-	-	-	-	-	-	-
12. *Gabbia orcula*	-	-	-	+	-	-	-	-	-	+	+	+	+
13. *Gabbia stenothyroides*	-	-	-	-	+	-	+	-	-	-	-	+	+
Order- Basommatophora													
Family- Planorbidae													
14. *Gyraulus convexiusculus*	-	-	-	-	-	+	+	+	+	-	+	+	+
15. *Gyraulus* sp.	+	-	-	-	-	-	-	+	-	-	+	+	-
Family- Bullinidae													
16. *Indoplanorbis exustus*	-	-	-	+	-	-	+	+	+	+	+	+	+
Family- Lymnaeoidea													
17. *Lymnaea accuminata*	+	-	-	+	+	-	+	+	-	+	+	+	+
18. *Lymnaea tuteola*	-	-	+	-	-	-	-	-	-	+	-	-	-
Class- Bivalvia													
Order- Trigoinoida													
Family- Unionidae													
19. *Lamellidens marginalis*	+	+	-	+	+	-	-	-	-	+	-	-	+
20. *Lamellidens corrianus*	-	-	-	-	-	-	+	-	-	-	-	+	+
21. *Parreysia favidens*	-	-	+	+	+	+	-	+	-	+	-	-	+
22. *Parreysia involuta*	-	-	-	-	-	-	-	-	-	+	-	-	+
23. *Parreysia cylindrica*	-	-	+	+	+	-	-	-	+	+	-	-	-
24. *Parreysia occata*	-	+	-	+	-	-	-	-	-	+	-	-	-
Order- Veneroida													
Family- Corbiculidae													
25. *Corbicula rajahensis*	-	-	-	-	-	-	-	-	-	-	-	-	+
26. *Corbicula peninsularis*	-	-	-	-	-	-	-	+	-	+	-	-	-
27. *Corbicula bensoni*	-	-	-	-	-	-	-	-	-	+	-	-	+
28. *Corbicula striatella*	-	-	+	-	+	-	-	-	-	+	+	+	+
29. *Corbicula* sp.	-	-	-	-	-	-	-	-	-	-	+	-	-
Family- Pisidiidae													
30. *Pisidium clarkeanum*	+	-	-	-	-	-	-	-	-	-	+	-	-

Table 2 cont .....

Systematic list of macrobenthic invertebrates	Name of the stations												
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**	**S12**	**S13**
Phylum- Arthropoda													
Class- Insecta													
Order- Ephemeroptera													
Family- Heptageniidae													
31. *Heptagenia* sp.	-	+	-	+	+	+	-	+	+	+	+	-	-
Family- Caenidae													
32. *Caenis* sp.	+	-	-	+	+	-	+	-	+	+	+	-	-
Family- Baetidae													
33. *Baetis* sp.	-	-	+	-	+	-	+	-	-	+	-	-	-
Order- Odonata													
Family- Gomphidae													
34. *Gomphus* sp.	+	-	+	-	+	+	-	+	+	+	+	+	+
35. *Ophiogomphus* sp.	-	-	-	-	+	-	-	-	-	+	-	-	-
Family- Coenargionidae													
36. *Argia* sp.	-	-	-	+	+	+	-	+	+	-	+	+	+
Order- Trichoptera													
Family- Hydropsychidae													
37. *Hydropsyche* sp.	-	-	-	-	-	-	+	-	-	+	-	+	-
Order- Hemiptera													
Family- Nepidae													
38. *Laccotrephes* sp.	-	-	-	-	-	-	-	-	-	+	-	-	-
Family- Corixidae													
39. *Hesperocorixa* sp.	+	-	+	+	-	+	-	-	+	+	+	-	-
Order- Coleoptera													
Family- Dytiscidae													
40. *Cybister* sp.	-	+	+	+	+	+	+	+	+	+	-	-	-
Order- Diptera													
Family- Chaoboridae													
41. *Chaoborus* larvae	-	-	-	+	-	+	-	-	-	-	-	-	-
Family- Culicidae													
42. *Culex* sp.	+	+	+	+	+	+	+	-	+	+	+	-	+
Family-Chinonomidae													
43. *Chironomus* sp.	+	-	+	+	-	+	+	-	+	-	+	+	+
Class- Malacostraca													
Order- Decapoda													
Family- Palaemonidae													
44. *Macrobrachium lamarrei*	-	-	-	-	-	-	-	+	-	-	-	-	-
45. *Macrobrachium tiwarii*	-	-	-	-	-	-	-	+	-	-	-	-	-
Family- Atyidae													
46. *Caridina* sp.	-	-	-	-	+	-	-	+	+	+	+	-	+
Family- Gecarcinucidae													
47. *Barytelphusa cunicularis*	-	-	-	-	-	-	-	-	-	-	-	+	-
Order- Mysida													
Family- Mysidae													
48. *Mysis* sp.	-	-	-	-	-	-	-	+	-	-	+	-	-
Class- Arachnida													
Order- Araneae													
Family- Dictynidae													
49. *Argyronet aaquatica*	-	-	-	-	-	-	-	-	-	-	-	+	-

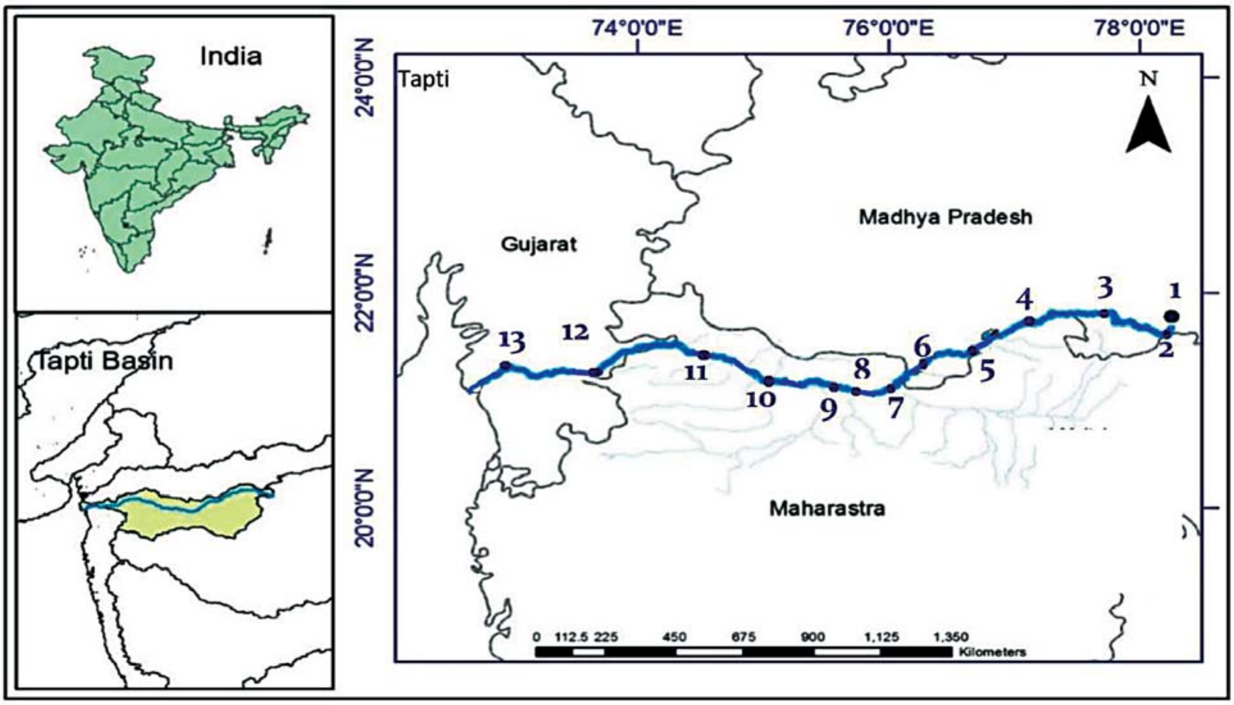

Fig. 1. Sampling sites along the course of river Tapti

Materials and methods

The present study was undertaken at the thirteen sampling sites in the river Tapti during the period from July 2017 to January 2020. The respective stations were Multai (S-1), Chadora (S-2), Betul (S-3), Dedtalai (S-4), Nepanagar (S-5) in the upper stretch, Burhanpur (S-6), Changdev (S-7), Bhusawal (S-8), Tapti Nagar (S-9) in the middle stretch, and Savkheda (S-10), Sarangkheda (S-11), Singalkhanch (S-12), and Kamrej (S-13) at the lower stretch of the river (Figure 1). Multai and Chandora were in close vicinity but the difference in their habitat was the reason for taking them as separate sampling stations. Other sampling stations in close vicinity were Bhusawal and Tapti Nagar, both with different habitat characteristics. The details of the sampling location are given in Table 1.

Sampling of macrobenthic invertebrates was carried out covering the upper, middle, and lower stretch of the river. The macrobenthic invertebrates were collected from the river bed sediment employing Peterson grab (20 cm × 16 cm) and by handpicking from the shallow and rocky bottoms where grab could not be employed. The fauna collected were washed several times to dislodge the attached fauna in a bucket filled with water. Bottom sediments and washed substrate were sieved through sieve number BS 40 (420 μm) and the organisms retained on the sieve were transferred to sample jars. The collected samples were preserved in 4% formalin and brought to the laboratory for identification. The sorted organisms were first segregated into different groups and then identified to specific, generic, or other higher taxonomic levels following standard taxonomic references (Edmondson, 1959; Rao, 1989; Dey, 2007; Needham and Needham, 1962).

Results and discussion

The macrobenthic invertebrate community structure in the river Tapti is comprised of 49 taxa from 5 classes. The class Gastropoda with 18 taxa was the most abundant group with the maximum number of species diver-

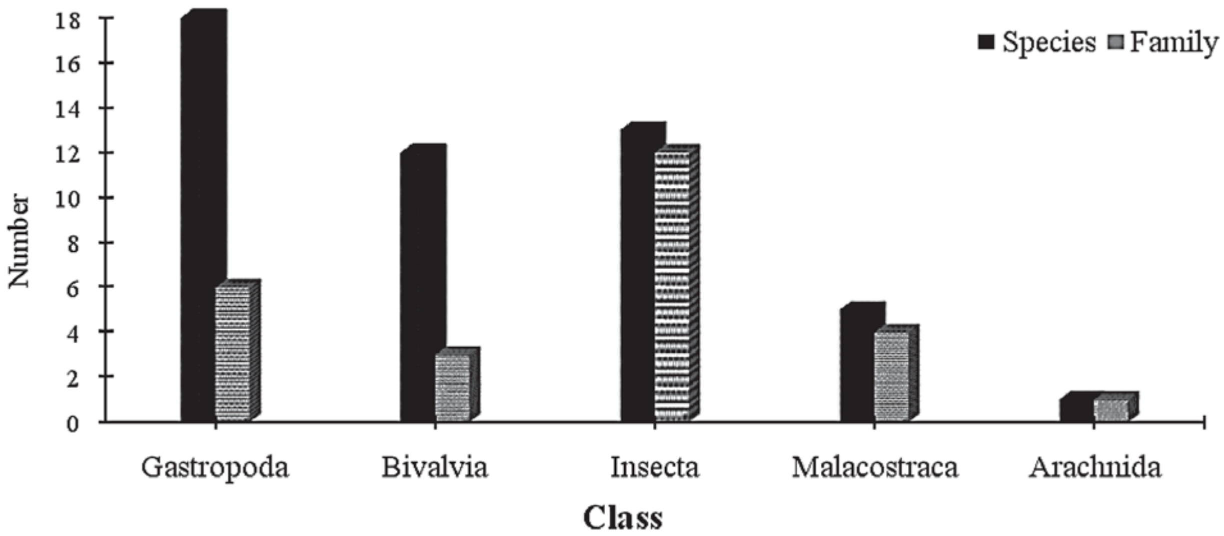

Fig. 2. Family and species-wise macrobenthic invertebrate community of river Tapti

sity. Insect diversity was accounted for 13 species and Bivalvia with 12 species. Gastropods, bivalves, and insects were the major contributors to the community composition of macrobenthic invertebrates in the river Tapti (Figure 2). Aquatic insects in their larval, pupal, and nymphal stages were also observed from the river during the study period. The 5 classes of macrobenthic invertebrates were Gastropoda, Bivalvia, Malacostraca, Insecta, and Arachnida. Among the three phyla of benthic macrobenthic invertebrates, Mollusca (58%) contributed maximum followed by Arthropoda (42%) in the community structure. The most abundant species identified under different classes were as follows: Gastropoda - *Tarebia lineata* and *Bellamya bengalensis*; Bivalvia –*Parreysia favidens* and *Corbiculla striatella*; class Insecta - *Caenis* sp. and *Chironomus* sp. The frequency and relative frequency of the species revealed that the most dominant species was *Bellamya bengalensis* from the Gastropoda. The community composition of macrobenthic invertebrates across stations is given in Table 2.

In the present study, we could observe that the phylum Mollusca (58%) was the most dominant group followed by Arthropoda (42%). Pir *et al.* (2010) studied the distribution of molluscs along the Omkareshwar and Mandleshwar stretch of river Narmada and reported a total of sixteen species. Kumar and Vyas (2012) investigated macro-invertebrates diversity in the central zone of river Narmada of Madhya Pradesh state, at the confluence point of river Narmada and its tributaries, and reported 19 species of molluscs, 13 species by gastropods, and 6 species of bivalves. Rai *et al.* (2016) reported thirteen molluscan species from two classes; nine species of annelids worms; twenty-five species of odonatan from seven families from the Jabalpur stretch of river Narmada from 2014 to 2015. Nair and Prajapati (2018) studied the benthic macro-invertebrate community in river Narmada from four sampling stations at Punasa, Omkareshwar, Mandelshwar, and Khalgat, and observed 33 species form five groups hereby molluscan were the dominant groups. Studies on the macrobenthic invertebrates in the west-flowing river like Narmada also revealed that the community structure of macrobenthic invertebrates similar to those of the current study.

Deo *et al.* (2016) studied benthic macro-invertebrates in four tributaries of the river Narmada in the central zone of India and, contrary to our study, identified 30 taxa from 8 sampling stations with phylum Arthropoda as the most dominant group (63%). Kumar *et al.* (2017) reported 26 taxa of benthic macro-zoo-benthos from the river Dudhi, a tributary of river Narmada with its confluence at Hoshangabad and revealed that the population of arthropod (77%) was dominant over molluscs (23%). The dominance of Arthropoda population is also reported in river Narmada (Kumar and Vyas, 2014), river Morand, a sub-tributary of river Narmada (Sharma *et al*., 2013), and near the water intake point of river Narmada (Vyas *et al*., 2012). Both Narmada and Tapti are the two major rivers of the west coast river system in India. The macrobenthic invertebrates species composition of these two rivers were almost similar as evident by comparing the present study with the earlier study at different stretches of river Narmada, and mostly at the central stretch of the river (Pir *et al*., 2010; Rai *et al*., 2016; Nair and Prajapati, 2018). The occurrence of more taxa (forty-nine) was observed in the river Tapti, which might be due to the most suitable habitats, and wide coverage of the study area in the river.

Conclusion

The present study provides a baseline for rapid biodiversity inventory of distribution, abundance, and diversity of macrobenthic invertebrates in river Tapti, India. The present findings indicate that the faunal community comprising of a variety of species forms an integral component of the riverine ecosystem but the degree of association and adaptation to such an environment differed from species to species. The health of the aquatic ecosystem can be ascertained by the composition of the flora and fauna present in the environment. Benthic organisms, due to their sessile and sedentary life history, are identified as one of the important biotic parameters to assess the health of an aquatic ecosystem.

Combliet of interest

The authors declare that there is no conflict of interest in this paper.

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